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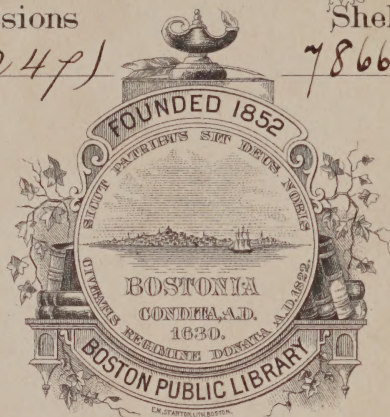
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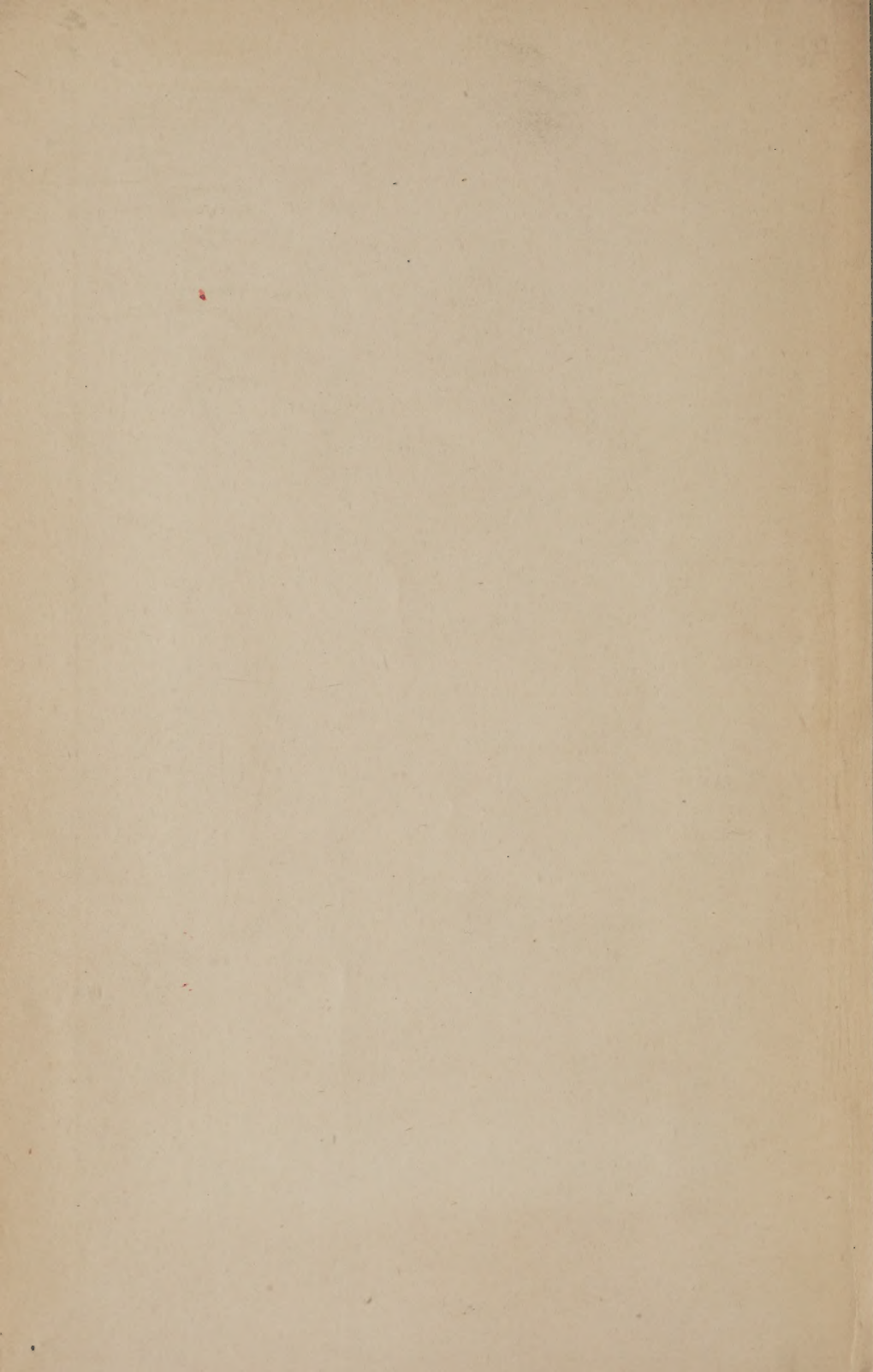
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Accurate Mountain Heights.

BY EDWARD C. PICKERING.

Read December 11, 1885.

OF the various methods of determining the height of a mountain, the best is undoubtedly that by running a line of levels to its summit. This method is accepted as the standard, and as that by which the errors of the other methods are to be judged. A surprising degree of accuracy can be attained in levelling an ordinary country. Many of the errors compensate, and the final results should generally be accurate within a small fraction of a foot. In ascending a mountain, much greater deviations must be expected. The back sights are usually longer than the fore sights, and therefore errors in the adjustment of the level or in the correction for atmospheric refraction are cumulative. The effect of the mass of the mountain on the level would produce an error which would not be compensated, and might be large enough to be appreciable. Finally, an error in the length of the levelling-rod would enter to its full proportionate amount. For these reasons much reliance should not be placed upon the fractions of a foot, unless the above sources of error have been considered and proper corrections applied. The precise heights as determined have, however, been given below.

The labor and cost of levelling prevent its general application to the determination of mountain heights. A few lines of level have been run up the hills and mountains in this portion of the country, generally by the enterprise and enthusiasm of volunteers. A description of several of these lines has been collected from various sources, generally from the local newspapers. The principal results are published below for permanent reference. Doubtless many similar measurements have been made, and it is hoped that they may be communicated to the writer as material for a second paper. As an example of the danger that such material may be totally lost, it may be mentioned that scarcely any of the results given below are contained in the excellent "Dictionary of Altitudes

of the United States," recently published by the United States Geological Survey.

The following table contains a number for reference, the name of the mountain or other object measured, and its height above the mean tide-level of the ocean. Additional information regarding many of these points is contained in the notes following the table. Nos. 1 to 10 are taken from "The Geology of New Hampshire," Vol. I.; Nos. 11 to 17 from an article by Mr. J. J. Holbrook, "New Hampshire Sentinel," Nov. 22, 1877, where the altitudes of several other points in Cheshire County, N. H., are also given. All of these stations are in New Hampshire; Nos. 18 to 43 are in Vermont, and Nos. 44 to 63 in New York.

	FEET
1. Mt. Washington	6,293
2. Upper water-tank, Mt. Washington Railroad . .	5,800
3. Second tank (Jacob's Ladder)	5,468
4. Waumbek Junction	3,910
5. Ammonoosuc Station	2,668
6. Half-way House	3,840
7. Glen House	1,632
8. Kearsarge (S.)	2,942.79
9. " Garden	2,622.50
10. " Plumbago Point	1,705
11. Monadnock	3,169.3
12. " Mountain House	2,071.984
13. John Mann's, near divide	1,487.602
14. Jaffrey Schoolhouse No. 12 (threshold)	1,231.227
15. Troy Schoolhouse No. 3 (lowest step)	1,166.112
16. Beech Hill	1,060.566
17. " " Reservoir	594.589
18. Mt. Mansfield (Chin)	4,389.08
19. Mt. Mansfield (Nose)	4,056.39
20. Summit House	3,841.64
21. Ridge southeast of Summit House	3,612.38
22. Half-way House	2,306.38
23. Junction of Notch Road	1,291.85
24. Bench near J. Houston's	955.05
25. Mansfield House, Stowe	720.27
26. Methodist Church, Waterbury Centre	712.53
27. Killington Peak	4,220.87
28. Summit of the second ridge	3,546.31
29. Rock, summit of the first ridge	3,385.48
30. Bench, rock near Manley's barn	2,097.61

	FEET
31. Bench, rock near R. Maxham's	1,812.72
32. Junction of the mountain road, Sherburne	1,504.77
33. Hotel, Sherburne	1,211.21
34. Congregational Church, Bridgewater	892.39
35. Mt. Tom (north peak), Woodstock	1,351.22
36. " (south peak), "	1,244.12
37. Little Killington	3,951
38. Base of the Town Hall, Woodstock	697.69
39. Pico	3,935
40. Shrewsbury Mountain	3,707
41. Shrewsbury Peak	3,838
42. Camel's Hump	4,077
43. Ascutney	3,163
44. Whiteface Mt.	4,871.655
45. " " (spring)	2,817.958
46. " " (brook, second crossing on trail)	2,023.965
47. " " (brook, first crossing on trail)	1,959.996
48. Lake Placid	1,863.715
49. Mt. Marcy	5,344.243
50. " " (Hump)	4,998.278
51. Lake Tear of the Clouds	4,321.958
52. " " " " (summit of notch)	4,355.313
53. Panther Gorge	3,353.687
54. Mt. MacIntyre	5,112.730
55. Mackenzie Pond Mountain	3,789.322
56. Mt. Skylight	4,889.626
57. Gray Peak	4,902
58. Haystack	4,918.626
59. Bartlett (west shoulder)	2,785.512
60. St. Regis Mountain	2,888.298
61. Lyon Mountain	3,809
62. St. Regis Lake (Lower)	1,623.162
63. Raquette Lake	1,774.249

1. The height of Mt. Washington was determined in 1853 by Captain Cram of the United States Coast Survey (C. S. Reports, 1854, p. 39, App. 34; 1870, p. 90). Another determination in 1852, by Mr. William A. Goodwin, gave the elevation as 6,285 ("The Geology of New Hampshire," vol. i. p. 88), and apparently resulted from a line of levels.

8 to 10. Carriage-road survey by Mr. R. S. Howe.

11 to 17. Levelled by Mr. J. J. Holbrook.

18 to 26. Levelled by Mr. Hosea Doton, aided by Messrs. W. W. Ware and J. K. P. Chamberlain. They started from the railway station at Waterbury, and assumed the height of the top of the sleepers at that

point to be 425 feet. Professor Guyot, in 1866, found the height of No. 18 to be 4,386 feet, from a series of barometric measurements made every fifteen minutes for twenty-four hours. Another measurement recently made by him gives the height 4,387.25 (reprinted from Walton's Journal in "Vermont Standard," Oct. 15, 1885, where the elevations of twelve other points on this line are also given). Mr. Doton states that he used an eighteen-inch Y-level made by J. Sawyer, of Yonkers, N. Y., with a "New York" rod. The back and fore sights are usually made as nearly equal as possible without actual measurement. When it was necessary to make the sights unequal, the correction for curvature and refraction was applied. The lines were run up the mountain, and not down. An independent determination of the heights of Nos. 18 and 19 has been made by the Hon. J. P. Bradley. A line of levels gave the height of the Butler House in Stowe to be 851.70. A triangulation from a base measured near this point gave the height of No. 18 to be 4,387.25 and of No. 19, 4,061.46. This is a close agreement, considering the means employed, and a satisfactory proof that no serious error occurs in the line of levels. A line of levels has been run to No. 18 by the Coast Survey, but the result has not yet been published (C. S. Report, 1883, p. 29).

27 to 37. In 1863 Mr. Hosea Doton, assisted by Messrs. W. S. Dewey, J. K. P. Chamberlain, and R. A. Perkins, ran this line of levels, starting from White River Junction. Professor Guyot, by a careful barometric measurement, found the height of No. 27 to be 4,221.39 ("Vermont Standard," Oct. 11, 1866, where the heights of forty-six other points on this line are also given). The height of White River Junction was assumed to be 351 feet. In "The Geology of New Hampshire" (vol. i. p. 251 *et seq.*) it is given as 369.237. If this value is correct, the heights of Nos. 27 to 37 should be increased by 18 feet.

38 to 41. Determined trigonometrically from No. 27, No. 38 is 2.55 miles north; No. 39 is .92 miles southerly; No. 40 is 2.50 miles southeasterly; No. 41, also called Mendon Peak, is 1.44 miles south of west ("Vermont Standard," Oct. 11, 1866). The height of No. 41 is there given erroneously as 3,898.

42. Levelled by Mr. Charles Collins at the time of the building of the Vermont Central Railroad, of which he was one of the engineers ("Vermont Standard," June 8, 1871).

43. Levelled by Messrs. H. F. Dunham and D. C. Bell from a bench in Harland ("Vermont Standard," June 8, 1881). The bench appears to have been the summit of Garvin Hill, which was levelled from the base of the town hall in Woodstock by Mr. Hosea Doton, assisted by Mr. Charles Marsh. For further details, see the "Woodstock Post," Jan. 16, 1874.

44 to 63. All of these heights have been taken from the "Seventh Report of the Adirondack Survey," by Mr. Verplanck Colvin. Unfortunately, this work is entirely out of print. The heights of a large

number of other points are given in the same work. No. 61 was not determined by levelling, but from the mean of two months' observation with the barometer.

The following additional heights of the rail at various railway stations may prove useful; they are taken from "The Geology of New Hampshire," Vol. I.: Winchendon, 992; Peterborough, 744; Keene, 478.58; Bellows Falls, 304.58; White River Junction, 369.237; Woodsville, 448; Manchester, 180.832; Concord, 252.397; Plymouth, 473; Warren, 736; Littleton, 817; Wing Road Junction, 1,019; Bethlehem, 1,187; Lancaster, 870; Groveton Junction, 901; Shelburne, 723; Gorham, 812; Conway Corner, 466; North Conway, 516; Fabyan House, 1,571. The height of the lower Connecticut Lake is 1,618.863. The height of the Twin Mountain Station, as given in "The Geology of New Hampshire," p. 266, is 1,446; as given on pages 274 and 288, it is 1,375. The height of Bacon's Mills is given on page 271 as 922; but is apparently copied erroneously, as 992, in the "New Hampshire Sentinel" for Nov. 22, 1877. In the latter paper attention is called to the fact that the height of Marlborough Station is given (and probably correctly) as 789 feet on page 260, while on page 284 the heights of two bridges in Swanzev are given as 1,072 and 1,022. The water flowing under these bridges (which are only of moderate height) comes from below the Marlborough Station.

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